

## MODERN WISDOM REGARDING TEENAGE BRAIN DEVELOPMENT

### The New Scientific Revelations About The Teenage Brain

Modern wisdom and scientific data support that brain development plays an integral role in violence.<sup>1</sup> It is now well established that different regions of the brain control different human functions. Moreover, each region of the brain matures at a different rate, and full brain development is not complete until early adulthood. These are truisms for the normal adolescent brain.

Recently discovered science regarding adolescent brain development is relevant in assessing juveniles involved in criminal behavior. See Lucy C. Ferguson, "*The Implications of Developmental Cognitive Research On 'Evolving Standards of Decency' and the Imposition of the Death Penalty on Juveniles,*" 54 AM.U. L. REV. 441, 463 ("Although brains suffering from frontal lobe dysfunction and mental retardation present more severe examples of the behavioral implications of an under-developed or damaged pre-frontal cortex than those of adolescent brains, there are some behavioral parallels between the groups.") (citation omitted) (2004). "Since 2000, numerous brain-scan studies have established that the human brain does not fully mature until an individual is in his or her early to mid-twenties." Ferguson, 54 AM U. L. REV. at 442.

Recent modern wisdom regarding brain development even in normal adolescents now well-accepted, reveals that the brain is not fully developed until the mid-twenties.

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<sup>1</sup> See Barry C. Feld, "*Competence, Culpability and Punishment: Implications of Atkins for Executing and Sentencing Adolescents,*" 32 HOFSTRA L. REV. 463, 544 (2003), citing *Thompson v. Oklahoma*, 487 U.S. 815, 834 (1988):

Adolescents as a class characteristically make poorer choices than do adults because of normal physical, neurobiological, psychological, and developmental processes. As the Supreme Court repeatedly has recognized, 'youth is more than a chronological fact. It is a time and condition of life when a person may be most susceptible to influence and to psychological damage. Our history is replete with laws and judicial recognition that minors, especially in their earlier years, generally are less mature and responsible than adults. Particularly "during the formative years of childhood and adolescence, minors often lack the experience, perspective, and judgment" expected of adults.'

See also *Roper v. Simmons*, 543 U.S. at 571-572 (acknowledging that juveniles, do not engage in the same sort of "cost-benefit analysis" as adults do), citing *Thompson v. Oklahoma*, 487 U.S. at 837.

Specifically the pre-frontal cortex of the brain, responsible for “executive” functions of planning and abstract thinking, is not fully developed until one’s early to mid-twenties.<sup>2</sup> Francine M. Benes, *The Development of Prefrontal Cortex: The Maturation of Neurotransmitter Systems and Their Interactions*, in HANDBOOK OF COGNITIVE NEUROSCIENCE 79, 79-89 (Charles A. Nelson & Monica Luciana eds., 2001) (concluding that the development of the prefrontal cortex “includes the early adult period and possibly even beyond”).<sup>3</sup>

From a clinical and social policy perspective, there is increasing recognition of the importance of emotions in decision making, relevant to a wide range of risk-taking behaviors. In many ways, this perspective increasingly blurs the traditional boundaries of cognitive

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<sup>2</sup>“While incomplete frontal lobe development in normal adolescents is likely not as extreme as in those with frontal lobe dysfunction or mental retardation, a comparison of cognitive and behavioral studies among these groups provides a better understanding of how juveniles’ immature brains can lead to a similar pattern of behavior.” Ferguson, 54 AM. U. L. REV. at 461 (emphasis supplied).

<sup>3</sup>See also, Jeffrey Fagan, *Atkins, Adolescence, and the Maturity Heuristic: Rationales for a Categorical Exemption for Juveniles from Capital Punishment*, 33 N.M. L. REV. 207, 238-39 (2003) (summarizing recent research reporting that “functions and regions of the brain regulating long-term planning, regulation of emotion, impulse control, and the evaluation of risk and reward... continue to mature over the course of adolescence, and **perhaps beyond age twenty and well into young adulthood**”); Ronald E. Dahl, *Affect Regulation, Brain Development, and Behavioral/Emotional Health in Adolescence*, 6 CNS SPECTRUMS 60, 69 (2001) (“Regions in the PFC [prefrontal cortex] that underpin higher cognitive-executive functions mature slowly, showing functional changes that continue well into late adolescence/adulthood.”). See also Richard Restak, M.D., *THE SECRET LIFE OF THE BRAIN* at 76 (The Dana Press and The John Henry Press, 2001) (“the prefrontal lobes **aren’t fully mature until the 20’s or even later**”); Feld, *supra*, 32 HOFSTRA L. REV. at 515 (citations omitted) (“[ne]urobiological evidence suggests **that the human brain does not achieve physiological maturity until the early twenties** and that adolescents simply do not have the same physiologic capability as adults to make mature decisions or to control impulsive behavior”), citing Elizabeth S. Scott & Laurence Steinberg, “*Blaming Youth*,” 81 TEX. L. REV. 799, 816 (2003) (“[R]egions of the brain implicated in processes of long-term planning, regulation of emotion, impulse control, and the evaluation of risk and reward continue to mature over the course of adolescence, and perhaps well into young adulthood. At puberty, changes in the limbic system--a part of the brain that is central in the processing and regulation of emotion--may stimulate adolescents to seek higher levels of novelty and to take more risks; these changes also may contribute to increased emotionality and vulnerability to stress. At the same time, patterns of development in the prefrontal cortex, which is active during the performance of complicated tasks involving planning and decision-making, suggest that these higher-order cognitive capacities may be immature well into middle adolescence. “)

vs. emotional processes. This is important because the "decision" to engage in a specific behavior that has long-term health consequences . . . cannot be completely understood within the framework of "cold" cognitive processes. Cold cognition refers to thinking under conditions of low emotion and/or arousal, whereas hot cognition refers to thinking under conditions of strong feelings or high arousal. The cognitive processes involved in hot cognition may, in fact, be much more important for understanding why people[--especially youths--] make risky choices in real-life situations. While adolescents' cognitive abilities to think and to reason may be comparable to adults', youths' interpersonal context, emotional responsivity, and inexperience affect the quality of their choices and behavior.

While psycho-social development proceeds through a series of stages, decision-making competencies emerge unevenly rather than as a uniform increase in overall capacity, and young people use different reasoning processes in different task domains. Differences in language ability, knowledge, experience, and culture affect the ages at which youths' various competencies emerge.

Feld, 32 HOFSTRA L. REV. at 504-505 (citations omitted). See also "Brain Immaturity Could Explain Teen Crash Rate," THE WASHINGTON POST, p. A-1 (February 1, 2005) (explaining that "an international effort led by [the] NIH's Institute of Mental Health and UCLA's Laboratory of Neuro-Imaging" has demonstrated that "the point of intellectual maturity, the 'age of reason'" does not occur until age 25; and quoting Jay Giedd, pediatric psychiatrist at the National Institute of Health as saying that "[t]eenagers' brains are not broken; they're just still under construction"); Gur, Ruben C., "Brain Maturation and the Execution of Juveniles: Some reflections on science and the law," THE PENNSYLVANIA GAZETTE (January/February 2005) at 14 ("some brain regions do not reach maturity in humans until adulthood . . . [as has] . . . been confirmed by more recent neuroimaging studies").

Dr. Ruben Gur, a professor of psychiatry in the Department of Psychiatry at the University of Pennsylvania and director of the Brain Behavior Laboratory in the School of Medicine at the University of Pennsylvania, has explained:

. . . The cortical regions that are the last to mature, particularly those in prefrontal areas, are involved in behavioral facets germane to many aspects of criminal culpability. Perhaps most relevant is the involvement of these brain regions in the control of aggression and other impulses, the process of planning for long-range goals, organization of sequential behavior, the process of abstraction and mental flexibility, and aspects of memory including 'working memory.' If the neural substrates of these behaviors have not reached maturity before adulthood,

it is unreasonable to expect the behaviors themselves to reflect mature thought processes.

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. . . [S]ince brain development in the relevant areas goes in phases that vary in rate and is usually not complete before the early to mid-20's, there is no way to state with any scientific reliability that an individual 17-year-old has a fully matured brain (and should be eligible for the most severe punishment), no matter how many otherwise accurate tests and measures might be applied to him . . .

Gur, Ruben C., "Brain Maturation and the Execution of Juveniles: Some reflections on science and the law," THE PENNSYLVANIA GAZETTE (January/February 2005) at 15.

[R]esearch shows that the pre-frontal cortex -- responsible for organization, decision-making, rational thought and other executive functions -- is the last part of the brain to mature. Instead of using the pre-frontal cortex to make decisions, research indicates that adolescents rely more heavily on the amygdala, the emotional center of the brain. Consequently, adolescents typically exhibit poorer risk assessment than adults and behave in a more impulsive manner.

Ferguson, 54 AM. U. L. REV. at 456 (citations omitted). *See also*, 54 AM U. L. REV. at 458 ("adolescents tend to have greater susceptibility to peer influence when making decisions and conducting cost-benefit analyses, lack realistic risk assessment abilities, and are not as future oriented as adults") (citations omitted).

Moreover "the rate of brain maturation can be severely retarded by abuse and neglect . . . and [t]hese and other factors serve to exacerbate a juvenile's cognitive immaturity, and consequently, lessen legal responsibility." *Id.* (citations omitted). Modern science through "brain imaging," has also taught that victims of trauma, who have suffered severe physical abuse, have "literally [had] the violent act[s] perpetrated against them] seared into their brains." Debra Niehoff, PhD., THE BIOLOGY OF VIOLENCE 112 (1999). *See also*, J.D. Bremner, P. Randall, and E. Vermetten, "Magnetic Based Imaging-based measurement of hippocampal volume in posttraumatic stress disorder related to physical and sexual abuse – A preliminary Report," *Biological Psychiatry* 41(1997): 23-32; Debra Niehoff, THE BIOLOGY OF VIOLENCE 280 (1999) ("A recent study, sponsored in part by the National Institute of Justice, provides the best evidence yet that children who are abused and neglected are at greater risk of arrest for a violent crime later in life"), *citing*, <http://www.ncjrs.org> *The Cycle of Violence Revisited* (1996), and C.S. Wisdom and M.G. Maxfield, *A Prospective Examination of Risk for Violence Among Abused and Neglected Children*, ANNALS OF THE NEW YORK ACADEMY OF SCIENCES (1996) 224-237.

The available scientific information about how the teenage brain functions is also relevant in understanding why juveniles become involved in criminal behavior:

Functional magnetic resonance imaging reveals that teenagers rely more heavily than adults on the amygdala and less heavily on the prefrontal cortex when responding to stressful stimuli. Thus, adolescent reactions to fear-evoking stimuli appear to be more instinctual responses rather than the product of cognitive processes.

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**Many adolescents' decisions about risky behavior appear to be more a function of "gut reactions" than of conscious thought processes. Just as organic features produce the developmental characteristics of mentally retarded defendants, similarly, the behaviors of adolescents may have a significant neurobiological component.**

Feld, 32 HOFSTRA L. REV. at 519-521 (citation omitted) (emphasis supplied). *See also* [www.waldorflibrary.org/Articles](http://www.waldorflibrary.org/Articles), THE HARVARD UNIVERSITY GAZETTE, "Deciphering The Adolescent Brain" (stating that research has shown that teenage brains rely "more on the amygdala, a structure in the temporal lobes known to be involved in discriminating fear and other emotions"); "Adolescence, Brain Development and Legal Culpability," American Bar Association (January 2004) (discussing findings of brain development research at Harvard Medical School that revealed that, based upon their incomplete brain development, "teenagers . . . respond more strongly with gut response than they do with evaluating the consequences of what they're doing").

#### Implications of the Science for Disposition and Sentencing

On March 1, 2005, in *Roper v. Simmons*, 543 U.S. 551, 567 (2005) the Supreme Court recognized that ". . . our society views juveniles, . . ., as categorically less culpable than the average criminal," *citing Atkins v. Virginia*, 536 U.S. 304, 316 (2002). *See also, Roper*, 543 U.S. at 572 ("The differences between juvenile and adult offenders are too marked and well understood . . .").

In *Roper*, the Supreme Court acknowledged three reasons that the sentence of a juvenile should be less severe than that which an adult offender guilty of the same conduct might warrant:<sup>4</sup>

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<sup>4</sup>Although *Roper* was decided in the context of the constitutionality of the death penalty for juvenile offenders, its rationale is no less applicable outside the context of capital punishment. *See generally* Timothy Cone, "Developing The Eighth Amendment for Those 'Least Deserving' Of Punishment: Statutory Mandatory Minimums for Non-Capital Offenses Can be 'Cruel and Unusual' When Imposed on Mentally Retarded Offenders," 34 N.M.L. REV. 35, 37-41 (2004).

Three general differences between juveniles under 18 and adults demonstrate that juvenile offenders cannot with reliability be classified among the worst offenders. First, as any parent knows and as the scientific and sociological studies . . . tend to confirm, . . . [a] lack of maturity and an underdeveloped sense of responsibility are found in youth more often than in adults and are more understandable among the young. These qualities often result in impetuous and ill-considered actions and decisions. . . . *Johnson v. Texas*, 509 U.S. 350,]367 [(1993)]; see also *Eddings v. Oklahoma*, 455 U.S. 104], 115-116 [(1982)] (“Even the normal 16-year-old customarily lacks the maturity of an adult”). It has been noted that “adolescents are overrepresented statistically in virtually every category of reckless behavior.” Arnett, *Reckless Behavior in Adolescence: A Developmental Perspective*, 12 DEVELOPMENTAL REVIEW 339 (1992). In recognition of the comparative immaturity and irresponsibility of juveniles, almost every State prohibits those under 18 years of age from voting, serving on juries, or marrying without parental consent.

The second area of difference is that juveniles are more vulnerable or susceptible to negative influences and outside pressures, including peer pressure. *Eddings, supra*, at 115 (“[Y]outh is more than a chronological fact. It is a time and condition of life when a person may be most susceptible to influence and to psychological damage”). This is explained in part by the prevailing circumstance that juveniles have less control, or less experience with control, over their own environment. See Steinberg & Scott, *Less Guilty by Reason of Adolescence: Developmental Immaturity, Diminished Responsibility, and the Juvenile Death Penalty*, 58 AM. PSYCHOLOGIST 1009, 1014 (2003) (hereinafter Steinberg & Scott) (“[A]s legal minors, lack the freedom that adults have to extricate themselves from a criminogenic setting”).

The third broad difference is that the character of a juvenile is not as well formed as that of an adult. The personality traits of juveniles are more transitory, less fixed. See generally E. Erikson, *IDENTITY: YOUTH AND CRISIS* (1968).

These differences render suspect any conclusion that a juvenile falls among the worst offenders. The susceptibility of juveniles to immature and irresponsible behavior means “**their irresponsible conduct is not as morally reprehensible as that of an adult**”. *Thompson v. Oklahoma*, 487 U.S. 815,] 835 [(1988)] (plurality opinion). **Their own vulnerability and comparative lack of control over their immediate surroundings mean juveniles have a greater claim than adults to be forgiven for failing to escape negative influences in their whole**

**environment.** See *Stanford [v. Kentucky 492 U.S. 361]*, 395 [(1989)] (Brennan, J., dissenting). The reality that juveniles still struggle to define their identity means it is less supportable to conclude that even a heinous crime committed by a juvenile is evidence of irretrievably depraved character. From a moral standpoint it would be misguided to equate the failings of a minor with those of an adult, for a greater possibility exists that a minor's character deficiencies will be reformed. Indeed, "[t]he relevance of youth as a mitigating factor derives from the fact that the signature qualities of youth are transient; as individuals mature, the impetuosity and recklessness that may dominate in younger years can subside." *Johnson, supra*, at 368; see also Steinberg & Scott 1014 ("For most teens, [risky or antisocial] behaviors are fleeting; they cease with maturity as individual identity becomes settled. Only a relatively small proportion of adolescents who experiment in risky or illegal activities develop entrenched patterns of problem behavior that persist into adulthood").

*Roper*, 543 U.S. at 569-570 (emphasis supplied).

Culpability has been recognized as "a shorthand for several interrelated phenomena, including responsibility, accountability, blameworthiness, and punishability." Laurence Steinberg, Elizabeth Cauffman "The Elephant In The Courtroom: A Developmental Perspective on The Adjudication Of Youthful Offenders," 6 VA. J. SOC. POL'Y & L. 389, 404-405 (1999). Beyond the "cognitive and social-cognitive capabilities that are potentially relevant to the assessment of blameworthiness, . . . [are] . . . also . . . certain capabilities that are more interpersonal or emotional than cognitive in nature. *Id.* at 407. These "psychosocial capabilities include "the ability to manage one's impulses, to manage one's behavior in the face of pressure from others to violate the law, or to extricate oneself from a potentially problematic situation." *Id.*

Culpability also has been explained as "the degree to which a defendant can be held accountable for his or her actions." Elizabeth Cauffman, Jennifer Woolard, N. Dickon Reppucci, "Justice for Juveniles: Perspectives on Adolescents' Competence and Culpability," 18 QLR 403, 415-416 (1999).

Culpability concerns the degree to which a defendant can be held accountable for his or her actions. In this context, immature judgment is considered as a possible mitigating circumstance which would render the defendant less blameworthy for transgressions committed. . . . [Y]ouths' offenses may stem in part from deficiencies in psychosocial factors that adversely affect judgment. If this is the case, then the presumptions of autonomy, free will and rational choice on which adult criminal responsibility is based become weaker. Under such circumstances, the criminal actions of juveniles are less blameworthy than similar acts

committed by adults. If this is so, then youths should be subject to less severe punishment . . . A legal response that holds youthful offenders accountable, while recognizing that they are less culpable than their adult counterparts, would provide criminal punishment without violating the underlying principle of proportionality, which suggests that punishment should be based, in part, on the blameworthiness of the offender.

*Id.*

Because the criminal law presumes free-willed moral actors -- those who morally can be blamed for wrong-doing -- it deems less culpable those whose capacity to make rational choices or whose ability to exercise self-control is significantly constrained by external circumstances or individual impairments. Youthfulness affects the actor's abilities to reason instrumentally and freely choose behavior, and locates an offender closer to the diminished responsibility end of the continuum than to the fully autonomous free-willed actor.

Feld, *supra*, 32 HOFSTRA L. REV. at 500-501 (citations omitted).

Criminal responsibility and moral blameworthiness hinge on cognitive and volitional competence. In a framework of deserved punishment, it is unjust to impose the same penalty on offenders who do not possess comparable culpability. Younger offenders are not as blameworthy as adults because they have not yet fully internalized moral norms, developed sufficient empathic identification with others, acquired adequate moral comprehension, or had sufficient opportunity to learn to control their actions. In short, they possess neither the rationality--cognitive capacity--nor the self-control--volitional capacity--to justify equating their criminal responsibility with that of adults.

*Id.* at 502 (citations omitted).

Penal proportionality dictates shorter sentences for youth because of diminished responsibility. While criminal law presumes autonomous choices by free-willed actors, adolescents have not yet acquired experience, self-control, and maturity of judgment to validate such a presumption. Even if a youth is criminally responsible for causing a particular harm, the law should not treat her choices as the moral equivalents of an adult's and impose the same sentence. Political sound-bites--"Adult crime, adult time," or "Old enough to do the crime, old enough to do the time"--provide simplistic answers to complex moral and legal questions.

*Id.* at 543. See also 6 VA. J. SOC. POL'Y & L. at 409 ("many individuals do not demonstrate adult-like psychosocial maturity or judgment even at age seventeen") (citation omitted). It has been observed that "when the individual under consideration is younger than seventeen, . . . **developmentally-normative immaturity should be added to the list of possible mitigating factors, along with the more typical ones of self-defense, mental state and extenuating circumstances.**" *Id.* citing 6 VA. J. SOC. POL'Y & L. at 410 (emphasis supplied). See also Kim Taylor-Thompson, "States of Mind/States of Development," 14 STAN. L. & POL'Y REV 143 (2003).

As explained by Professor Feld,

[A]ll of the developmental characteristics that render adolescent offenders less culpable--impaired judgment and reasoning, limited impulse control, and susceptibility to peer influences--also reduce the likelihood that the threat of execution or draconian sentences will have any appreciable deterrent effect on younger offenders decisions to commit crimes.

Feld, 32 HOFSTRA L. REV at 521. Professor Feld has stated further:

Shorter sentences recognize that young offenders' choices differ qualitatively from those of adults and enable them to survive their serious mistakes with a semblance of life chances intact. They also recognize that the same-length sentences impose a greater "penal bite" on younger offenders than they do on their older counterparts. A formal mitigation of punishment based on youthfulness avoids inflicting disproportionately harsh penalties on less culpable offenders without excusing their criminal conduct. Youthfulness constitutes a categorical form of diminished responsibility because young people as a group make choices that differ qualitatively from those of adults. . . . The research evidence is strongest that the maturity of judgment and adjudicative competence of the youngest adolescents is qualitatively lower than that of typical adult offenders. . . . Because reduced culpability provides the rationale for youthful mitigation, younger adolescents bear less responsibility and deserve proportionally shorter sentences than older youths.

Feld, 32 HOFSTRA L. REV. at 551-552.